

Fig. 1. Collembolan succession in plant remains under experimental conditions

a) leaf litter compost in a mixed forest

1 - I. violacea; 2 - Sminthuridae gen.sp.; 3 - L. lanuginosus; 4 - N. muscorum; 5 - I. minor; 6 - I. notabilis; 7 - F. quadrioculata; 8 - Onychiurus spp.; 9 - other hemiedaphic spp.; 10 - other euedaphic spp.;

b) leaf litter compost in a farm area

1 - H. manubrialis; 2 - H. assimilis; 3 - L. cyaneus; 4 - P. minuta; 5 - F. mirabilis; 6 - I. notabilis; 7 - N. muscorum; 8 - P. alba; 9 - Onychiurus spp.; 10 - M. krausbaueri;

c) leaf litter placed into arable soil

1 - H. manubrialis; 2 - I. notabilis; 3 - F. fimetaria; 4 - M. krausbaueri

leaf litter in compost heaps placed in a forest. In this case dominants are replaced gradually, without well-defined stages (Fig. 1a). The differences in a population composition are manifested only after a long periods of time. First, the Schannon index is high and changes insignificantly, but it considerably declines the next year (Fig. 2a). A succession is largely developing as an independent process.

The composition of collembolan species involved in a succession is significantly different in the compost heaps of the same material placed in the farm areas (Fig. 1b). The total species diversity declines to 15-20 species.

SPECIES DIVERSITY AND SUCCESSIONAL CHANGES IN POPULATIONS OF COLLEMBOLA

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ВИДОВОЕ РАЗНООБРАЗИЕ И СУКЦЕССИОННЫЕ СМЕНЫ КОЛЛЕМБОЛОВ

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Study of the dynamics of collembolan complexes in the processes of decomposition of organic matter provides a model in the general theory of succession.

A number of geobotanists concerned with the succession problem have inferred a rigid pattern of the consecutive stages in the course of vegetation changes in the successive series. Many investigators are inclined to extend this opinion to all succession types in animal populations. The question also arises regarding the relationship between the species diversity of animal groups and the succession pattern.

In our field experiments we placed the same organic material under various conditions determining different species diversity of collembolan communities, involved in the process of decomposition.

The present study summarizes the results of some 20 years of research. The community of 40-50 collembolan species is involved in the decomposition of

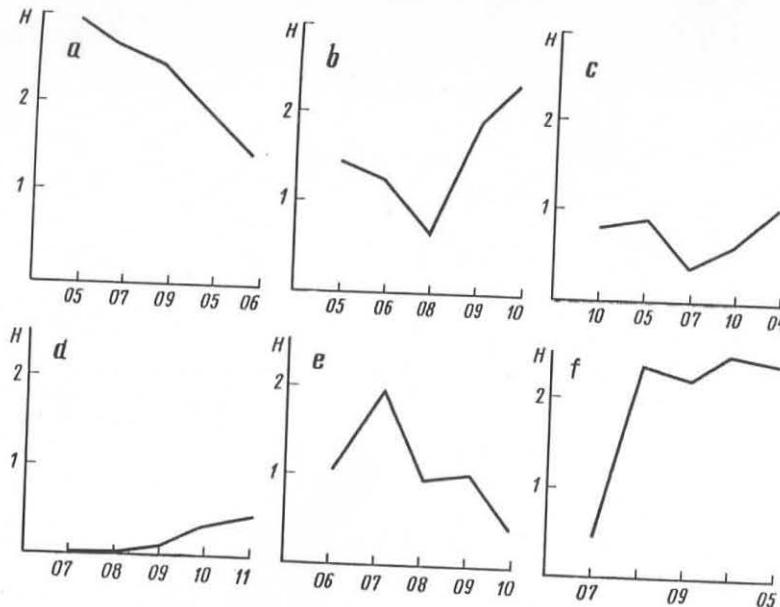


Fig. 2. Change of index of species diversity (Shannon) in the different variants of succession

a - foliar compost in the forest; b - foliar compost in the field; c - foliage in the soil; d - manure; e - turf-y-manual compost; f - manure in the soil

In such communities the succession pattern is not gradual, with few dominants being sharply replaced. The stages of community development are pronounced. The diversity index increases considerably after its sharp decline during the period of community re-arrangement (Fig. 2b). The rate of individual succession stages shows a closer relation relationship with the environmental conditions.

In the third experimental variant decomposition of large portions of leaf-fall in the arable soil layer was followed by a drastic species impoverishment of the community (to 5-7 species) (Fig. 1c). In this case the succession practically did not proceed. It is only revealed in the appearance and disappearance of some species and is not manifested in changes of main dominants. 1-2 species are dominants and their dynamics becomes an oscillating process controlled by the environment. In such impoverished series the maximal level of the total abundance of Collembola and of their total biomass per unit of substrate weight is reached. This is indirect evidence of declined interspecific competition. During the whole course of decomposition a community changes indirectly. The diversity index is constantly low (Fig. 2c).

An entirely different succession pattern was revealed during the decomposition of such high energy substrate as horse manure in the same conditions. In farm dunghills an undivided dominance of one species was observed during several months. The appearance of new animal forms in the successional se-

ries is strongly retarded in spite of the considerable extent of substrat decomposition. Originally the diversity index is extremely low but subsequently it gradually increases. Its pattern is in sharp contrast to that observed in leat composts (Fig. 2d).

When the composts are added some inert material (peat) a collembolan community is more diversified at the very beginning (4-5 species) and is soon enriched by new forms. The succession is strongly pronounced, with the distinct stages. The succession is also well defined in large portions of manure placed into the soil. A quick change of dominants takes place, species diversity increasing. The shannon index augments sharply during the succession and remains high up to the ultimate stages of decomposition (Fig. 2f).

Thus, successional changes of collembolan communities are extremely variable in the energetically identical materials under different conditions. They are distinguished by poorly-defined stages and a great variety in the ways of achieving the final states of community. The successional course in some series may be exactly the opposite. However this variability is determined not only by the environment but it is evidently associated with species variety of the community. This is indirect evidence of a great significance of competitive relationships among saprophages in the determination of rates and stages of successions.

The models discussed above may be interpreted in terms of the general problem of successions determination.

Discussion

Dunger W.: I think there are many processes involved in the colonization of organic material, e.g., the "normal" population dynamic of species. The vertical migrations and the time succession in using the nutritional source. Are you able to distinguish these processes involved in results you offered?

Chernova N.M.: Мы изучали соотношение сукцессионной и сезонной динамики популяций. Обнаружили группу видов, которые легко меняют место в сукцессионных рядах в связи с изменением погодных факторов. Но обнаруживается и другая группа видов, которые строго приурочены к отдельным этапам сукцессии, а влияние внешних условий меняет лишь их относительное обилие. Наше общее впечатление, что сукцессии у коллембол слабо детерминированы и бесконечно варьируют в деталях.

Вопрос: Изучали ли индивидуальные темпы размножения видов и их влияние на ход сукцессионной динамики?

Chernova N.M.: Да, изучали. Темпы размножения отдельных видов испытывают сильное влияние среди. Тем не менее имеется определенная связь между возможностью (способностью) вида менять место в сукцессионной серии и особенностями его размножения. Но это еще требует проверки.